THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

132/3A **CHEMISTRY 3A**

ALTERNATIVE A PRACTICAL

(For Both School and Private Candidates)

Time: 3 Hours *Wednesday 13th February 2008 a.m.*

Instructions

1. This paper consists of **three (3)** questions.
2. Answer **all** questions.
3. Question **number 1** carries 20 marks and the other **two (2)**, 15 marks each.
4. Non-programmable calculators may be used.
5. Cellular phones are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).

You may use the following:

C = 12, H = 1, O = 16, S = 32, Na = 23, I = 127, K=30, Mn=55, Ba=137

Molar gas constant, R = 8.314 J $mol^{-1}K^{-1}$

This paper consists of 5 printed pages.

1. You are provided with the following:

F_1 is an acidified solution of hydrogen peroxide obtained by reacting 8.45 g of the metal (M) peroxide, MO_2, with dilute H_2SO_4 and making the resultant solution to 1 dm^3 using distilled water.

F_2 is a solution of potassium permanganate (VII), $KMnO_4$, made by dissolving 3.16 g of the manganate in 1dm^3 of distilled water.

Theory:

A quantitative reaction occurs between peroxide of metal M and dilute H_2SO_4 according to the following equation:

$$MO_{2\,(s)} + H_2SO_{4\,(aq)} \rightarrow MSO_{4\,(s)} + H_2O_{2\,(aq)}$$

Procedure:

(i) Pipette 20 cm^3 (or 25 cm^3) of an acidified solution F_1 into a titration flask. Put solution F_2 in the burette. Titrate solution F_1 with solution F_2 from the burette until a permanent faint pink colour is observed.

(ii) Repeat procedure 1(i) above for at least three times. Record your results in a table.

Results:

The volume of the pipette used was _____cm^3

Table of Results:

Burette readings (cm^3)	Pilot	1	2	3
Final reading (cm^3)				
Initial reading (cm^3)				
Titre value (cm^3)				

Summary: _____ cm^3 of solution F_1 required _____ cm^3 of solution F_2 for complete reaction.

Problems:

From the experiment you have performed:

(a) Write the overall ionic equation for the reaction between hydrogen peroxide and potassium permanganate (VII) in acidic medium.

(b) Calculate the concentration of hydrogen peroxide in mol dm^{-3}.

(c) Calculate the atomic mass of the metal M in the metal peroxide MO_2

(d) Suggest the identity of the metal M.

(20 marks)

2. You are provided with the following:

AB: 2.0 M NaOH solution

CD: 2.0 M HCl solution

EF: 2.0 M CH_3COOH solution

Thermometer

Plastic beaker (calorimeter)

Measuring cylinder

Theory:

Enthalpy change when neutralization reaction takes place can be determined experimentally by measuring the temperature change when the acid and base are mixed. Assuming no heat is lost, the enthalpy change, q, in this experiment can be calculated using the equation:

$$q = -\rho v\, c\Delta t$$

where ρ = density of the solution (use $1 g/cm^3$)

c = specific heat capacity of the solution (use 4.2 $Jg^{-1}\ deg^{-1}$)

v = Total volume of the solution after mixing.

t = temperature change

Procedure

(i) Measure 100 cm^3 of solution AB using measuring cylinder. Pour this solution into a clean plastic beaker provided. Record the temperature of solution AB in the beaker, t_A = ____ °C.

(ii) Rinse the measuring cylinder with distilled water and use it to measure 100 cm^3 of solution CD. Measure and record the temperature of solution CD in the measuring cylinder, t_B = ____ °C

(iii) Pour the contents of the measuring cylinder into the plastic beaker already containing AB. Using your thermometer gently stir the solutions in the beaker and record the final temperature reached, t_f = ____ °C

(iv) Throw away the contents of the calorimeter and wash the beaker, thermometer and the measuring cylinder.

(v) Repeat procedures (i) – (iv) above, but this time using solutions AB and EF.

(vi) Record all your readings in the table as shown below:

	Final Temperature	Initial Temperature	Temperature change	Total volume	Mass of solution
Experiment 1					
Experiment 2					

(a) Calculate the heat change

(i) in the first experiment.

(ii) in the second experiment.

(b) Calculate the molar enthalpy of neutralization for the reactions:

(i) $NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(\ell)}$

(ii) $NaOH_{(aq)} + CH_3COOH_{(aq)} \rightarrow CH_3COONa_{(aq)} + H_2O_{(\ell)}$

(c) Compare the two values. What can you say about the molar enthalpy of neutralization in the second reaction if you compare it with that in the first experiment?

(15 marks)

3. You are provided with the following:

L_1: 0.10 M sodium hydroxide

L_2: Solution containing an unknown concentration of succinic acid

L_3: Ethoxyethane

Distilled water

Phenolphthalein indicator (POP)

Theory:

At constant temperature, succinic acid dissolves in both water and ethoxyethane while maintaining a constant ratio of concentrations in the solvents under consideration.

Procedure 1:

(i) Pipette 20 cm^3 (or 25 cm^3) of L_2 into a clean conical flask. Add 2 or 3 drops of POP to it.

(ii) Put L_1 in the burette.

(iii) Titrate very carefully solution L_2 against L_1 till there is a colour change. Record the volume of L_1 used as well as the room temperature.

(a) Results

(i) Volume of the pipette used was _____ cm^3.

(ii) Volume of L_1 used was _____ cm^3.

(iii) 3: Room temperature was _____ °C.

Procedure 2:

(i) Measure 75.0 cm^3 of L_3 using a measuring cylinder and put them in a separating funnel. Add to it 75.0 cm^3 of distilled water.

(ii) Measure 7.5 cm^3 of L_2 using measuring cylinder and put it into the funnel in (i) above. Shake well and allow the system to stand for a few minutes.

(iii) Run off the aqueous layer. Using a clean pipette, take 20 cm^3 (or 25 cm^3) of the aqueous layer into a clean conical flask.

(iv) Titrate very carefully this aliquot against L_1. Record the volume of L_1 used.

(b) Results:

(i) Volume of the aqueous layer taken was ____cm^3.

(ii) Volume of L_1 used was ___cm^3.

(c) Write a balanced chemical equation representing the reaction taking place in (iii) of procedure 1.

(d) Calculate the

(i) initial concentration of L_2 in water.

(ii) final concentration of L_2 in the aqueous layer.

(e) Deduce the concentration of L_2 in the organic layer.

(f) Calculate the partition coefficient of L_2 between water and ethoxyethane.

(15 marks)